THE WEATHER AND CIRCULATION OF AUGUST 1951[1]

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The general circulation of the Northern Hemisphere (fig. 1) for August was dominated by four major full-latitude waves, each extending from the polar region to the subtropics. The four major trough lines can be seen on figure 1; one along the east coast of North America, a second along the west coast of Europe and Africa, a third through central Asia, and the fourth extending southwestward from the Arctic Ocean through the Bering Sea and the western Pacific Ocean. Over the Eastern Hemisphere these waves had a larger amplitude than over the Western Hemisphere, where the circulation in middle latitudes was characterized by a zone of relatively strong flat westerlies.

To the south of this zone of strong westerlies the subtropical high pressure cells appeared as rather narrow elongated east-west ridges. The Pacific high pressure belt extended from California to China, while the elongated "Bermuda High" reached as far west as Lower California, with one center in Louisiana and the other in the central Atlantic. The easterly circulation around the southern periphery of this elongated "Bermuda High"

[1] See charts I-XV following p. 167, for analyzed climatological data for the month.

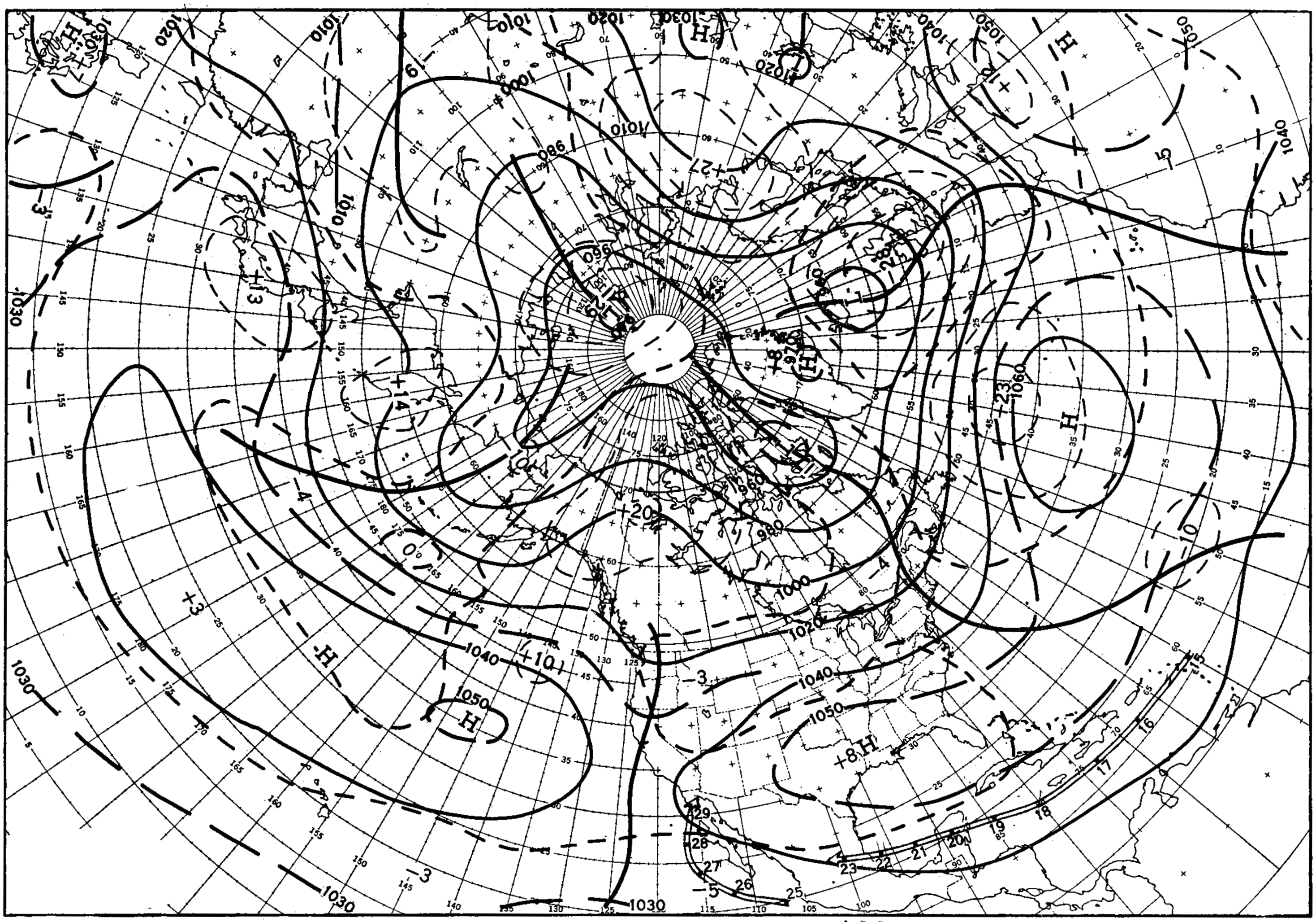


FIGURE 1.—Mean 700-mb. chart for the 30-day period July 31–August 29, 1951. Contours at 200-ft. intervals are shown by solid lines, intermediate contours by lines with long dashes and 700-mb. height departures from normal at 100-ft. intervals by lines with short dashes with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Minimum latitude trough locations are shown by heavy solid lines. Open arrows in Caribbean and near Lower California indicate hurricane paths.

swept in an uninterrupted zone across the Atlantic and the Caribbean into northern Mexico and the southwestern part of the United States. A similar broad belt of easterly trade winds prevailed over the Pacific Ocean.

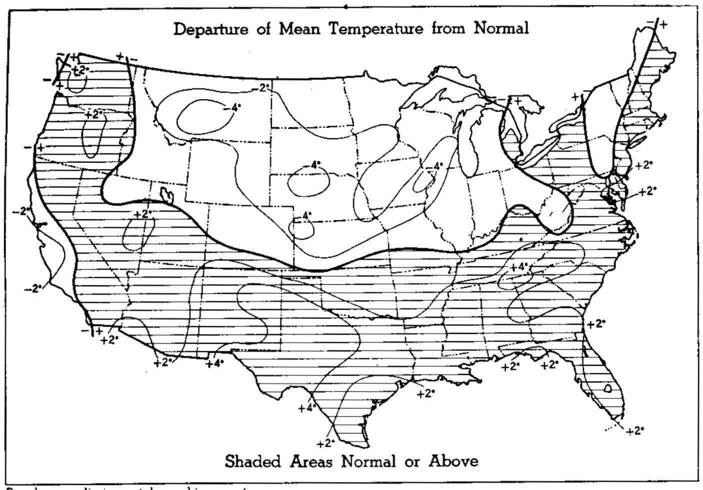
On figure 1 it may be noted that between the two cells of the subtropical high pressure belt there was a minor trough off the west coast of the United States, extending northward into British Columbia. To the north of this weak low-latitude trough a strongly developed ridge was crested in northwestern Canada. This strong ridge, oscillating in position between the Gulf of Alaska and northwestern Canada, led to an abnormally large number of cold air outbreaks in the northern United States during the 1951 summer. Nowhere else in the Northern Hemisphere did the general circulation exhibit this out-of-phase relationship between a ridge to the north and a trough to the south. Therefore, nowhere else on the map was there such a zone of marked confluence as was found along the northern border of the United States. The principal effect of this confluence was to intensify the meridional temperature gradient and increase the speed of the westerly winds across the northern United States and to the east over the Atlantic. As a result, the monthly mean storm track for August was that of the typical "Northern Pacific" type storm [1]. Most of the cyclones (Chart X) traversed the area on figure 1 where negative mean height anomalies appear. (Note 30-foot anomaly center in western Montana.) Behind each individual storm which moved along this track, cold air rushed southward from central Canada. However, the greater part of this cold air was swept eastward out to sea by the powerful westerlies before it could penetrate the southern United States. The storm tracks on Chart X show that no storms of the "Texas type" or "East Gulf type" were observed during this month.

The complete absence of any strong cold air outbreaks from the north, associated with the presence of a pronounced ridge aloft, produced one of the most prolonged heat waves ever experienced in the southern United States. Normally during summer occasional easterly waves bring cloudiness, precipitation, and relatively cool temperatures to the Gulf States. During this month, however, all easterly waves were displaced far to the south around the upper level ridge, leaving the Gulf States broiling in bright sunshine day after day (Chart VII). There was no respite because the upper level ridge, although not unusually intense, was remarkable for its great stability, varying little in position and magnitude from day to day.

Temperatures averaged from 4° to 6° above normal every week of the month throughout most of the west Gulf States. In many Texas cities above-normal temperatures were recorded every single day. Temperatures of 100° F., or more, were recorded in Texas on 29 days during August. In Dallas, the hottest day was August 17 when for 9 consecutive hours the temperature remained above the 100° F. mark. As of September 1 the temperature had climbed above 100° on 30 days in Dallas and on 94 days in the Rio Grande valley. Drought, the inevitable companion of extended summer hot spells, was prevalent throughout most of Texas. Presidio, with 0.06 inch of rain, experienced the driest August of its history. The warm dry air was by no means restricted to Texas, above-normal temperatures and deficient precipitation were reported over most of the area south of the principal storm track. (Charts I and III.)

North of this track the moist, cool weather which had characterized much of July persisted. The interaction of cool air from the north and warm air from the south resulted in less than usual sunshine, below-normal temperatures, and abundant precipitation through the Lake Region and the Plains from Kansas to the Canadian border. The mechanism causing this precipitation was similar to that which had produced the heavy rains in this region throughout the summer [2, 3]. The band of heaviest precipitation associated with the polar front moved gradually northward, giving floods in Kansas in late June and early July and more general rains across the northern United States in August. The effect of these rains in Iowa and in other nearby portions of the Corn Belt was to delay the maturation of the corn crop to such an extent that about 30 percent of the crop would be lost if the first killing frost occurred at its normal fall date.

The precipitation area in the Plains States merged to the southwest with another region of heavy rains, the lower Colorado River Basin of Arizona and California. Here the precipitation could be traced to the influence of two tropical hurricanes. The paths of these storms are shown on figure 1 and Chart X. The first hurricane, "Charlie," was initially sighted on August 15, just east of the Lesser Antilles. It moved in a nearly straight line around the periphery of the subtropical ridge into Mexico just north of Tampico. The stability of this ridge is illustrated by the closeness of the fit between the storm track and the mean flow pattern in this area (fig. 1). The moisture from this storm caused torrential downpours over Mexico during the last ten days of August; flooding there caused over 400 deaths. The heavy rains extended as far north as Brownsville, Tex., as the storm battered the east coast of Mexico. The tropical storm itself became dissipated over the land but the prevailing southeasterly winds carried the moisture from the hurricane across Mexico and over the mountains into the Pacific, where a new tropical cyclone developed off the coast. The circulation around this second disturbance dispersed the moisture, resulting in rain in California, Arizona, the southern tip of Nevada, western New Mexico, and to the northeast. Portions of the desert areas of the Southwest were flooded for several days, the rainfall there exceeding the heaviest observed in the past 11 years. (A



Based on preliminary telegraphic reports

FIGURE 2.—Departure of mean temperature from normal for the summer season (June, July, August) 1951. (From U. S. Weather Bureau *Weekly Weather and Crop Bulletin* for week ending September 18, 1951.)

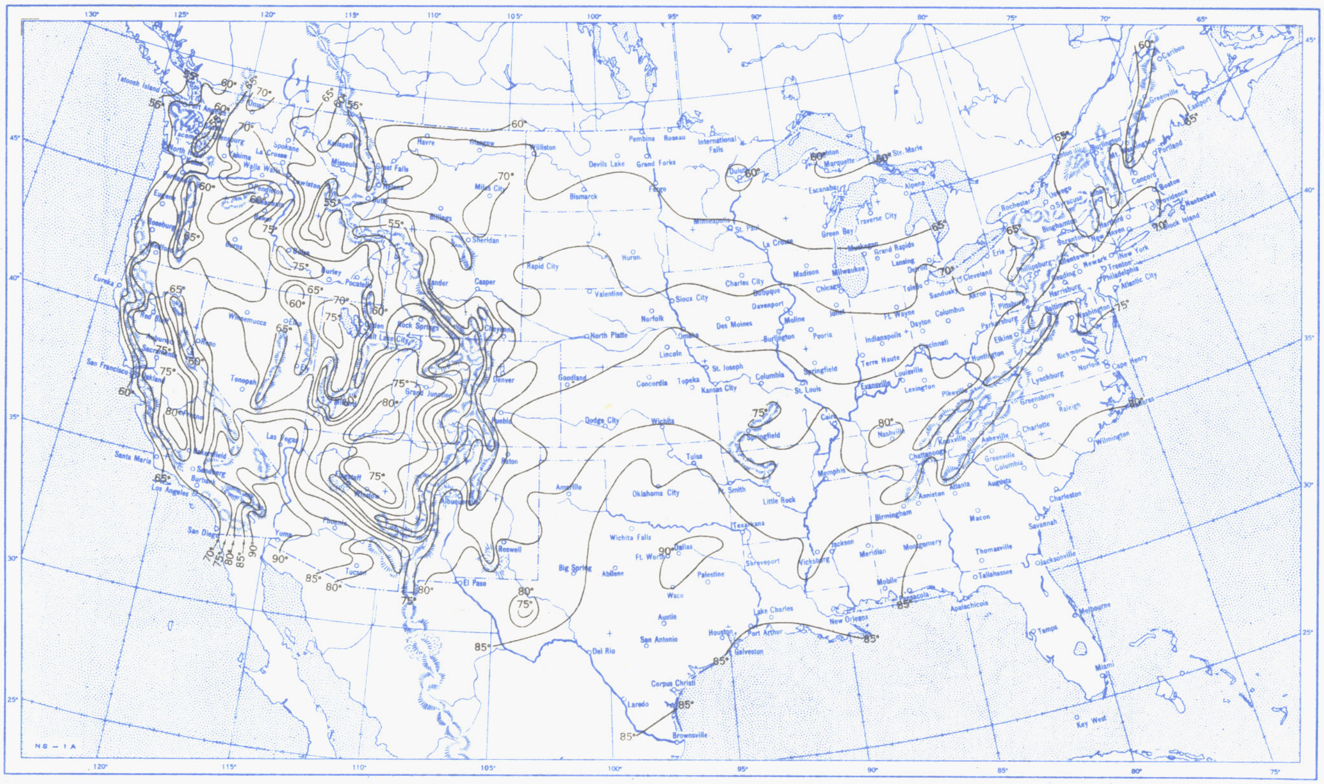
more detailed discussion of these heavy rains can be found in the article by J. A. Carr, p. 163 of this issue.)

In retrospect, the general circulation over North America differed in August only slightly from what it had been in June and July [2, 3]. The strong ridge in northwestern Canada and the Gulf of Alaska, a dominant feature of the summer season, and the strong ridge extending east-west along the southern border of the United States interacted to produce rather similar weather patterns each month throughout the summer. As a result the chart showing the temperature anomaly distribution in the United States in August (Chart I–B) closely resembles the corresponding chart for the summer as a whole (fig. 2).

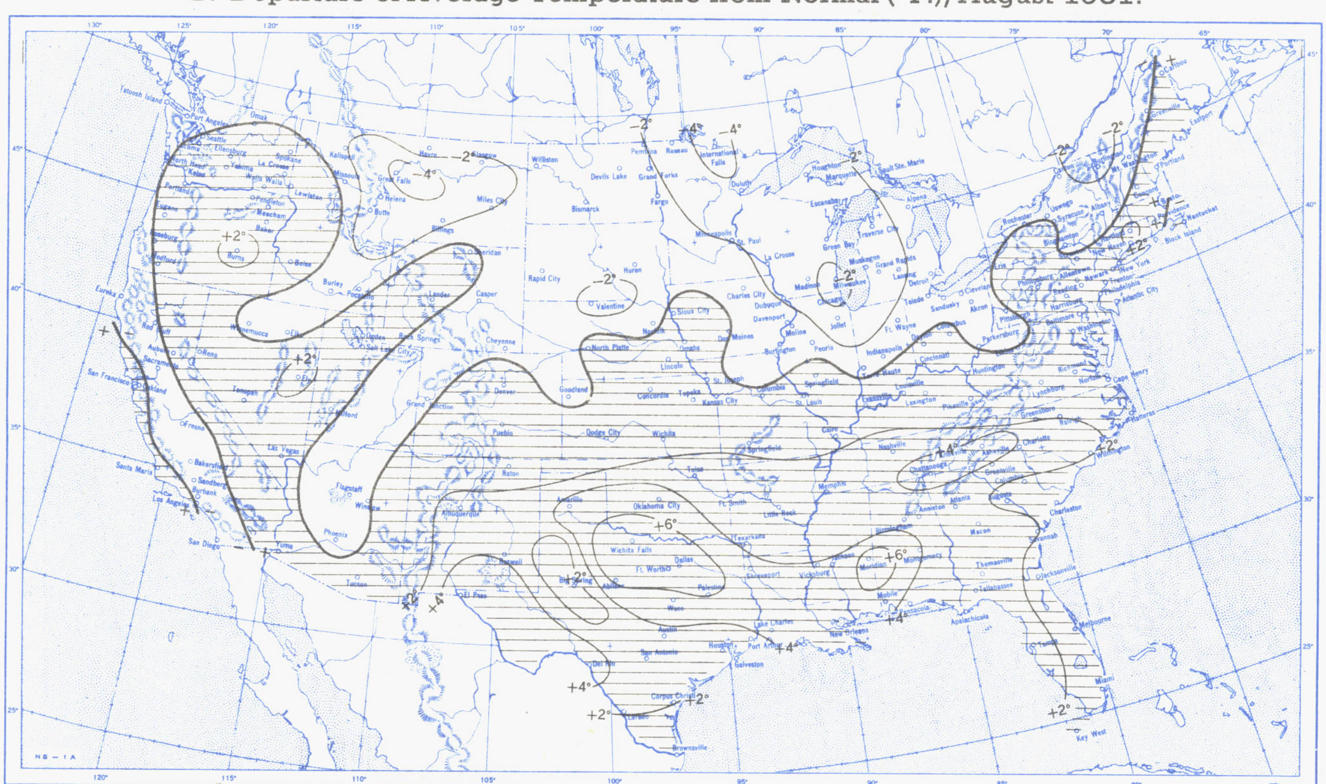
REFERENCES

1. E. H. Bowie and R. H. Weightman, "Types of Storms of the United States and their Average Movements," *Monthly Weather Review, Supplement No. 1*, Washington, D. C., 1914.
2. L. H. Clem, "The Weather and Circulation of June 1951," *Monthly Weather Review*, vol. 79, No. 6, June 1951, pp. 125–128.
3. V. J. Oliver, "The Weather and Circulation of July 1951," *Monthly Weather Review*, vol. 79, No. 7, July 1951, pp. 143–146.

Chart I. A. Average Temperature (°F.) at Surface, August 1951.

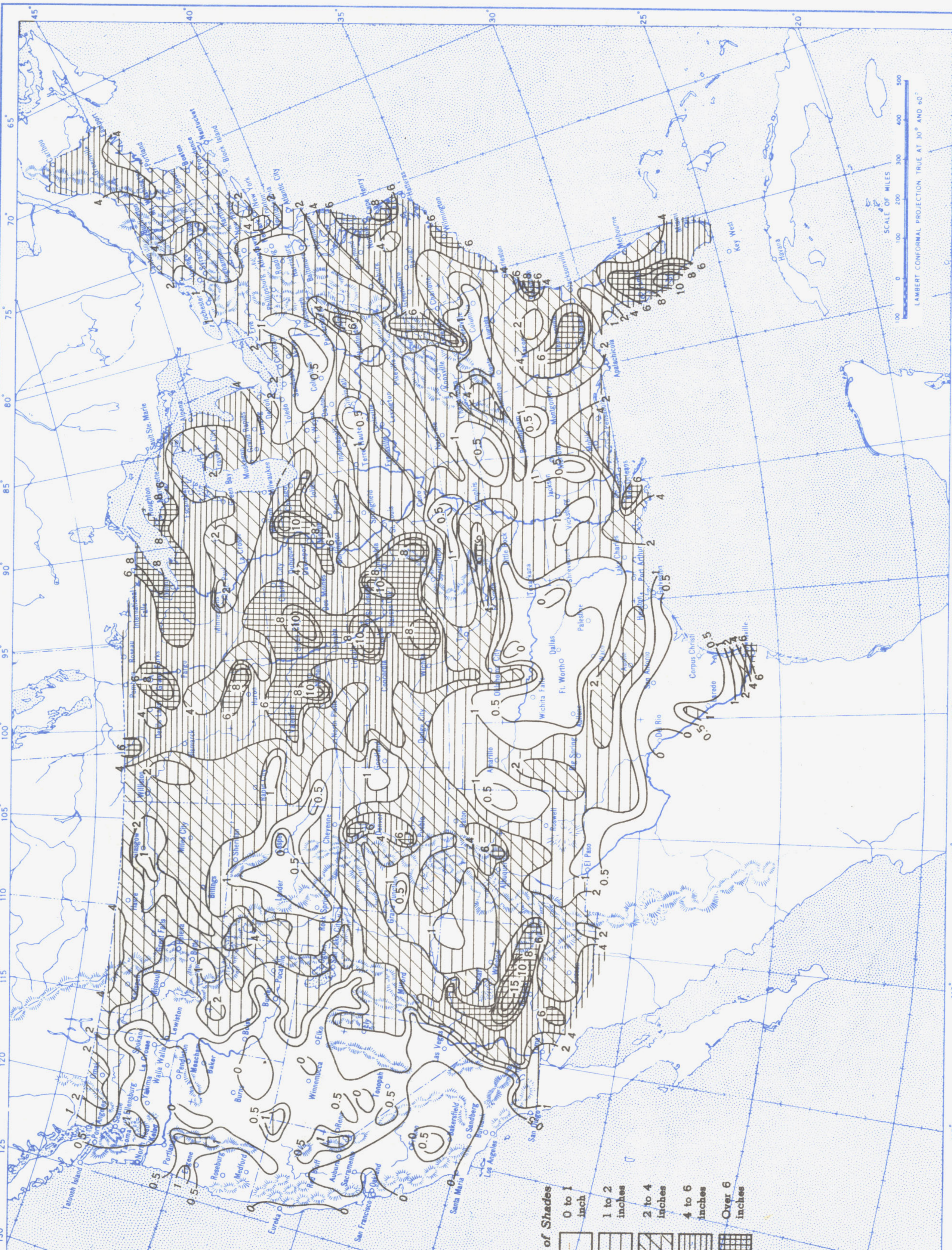


B. Departure of Average Temperature from Normal (°F.), August 1951.



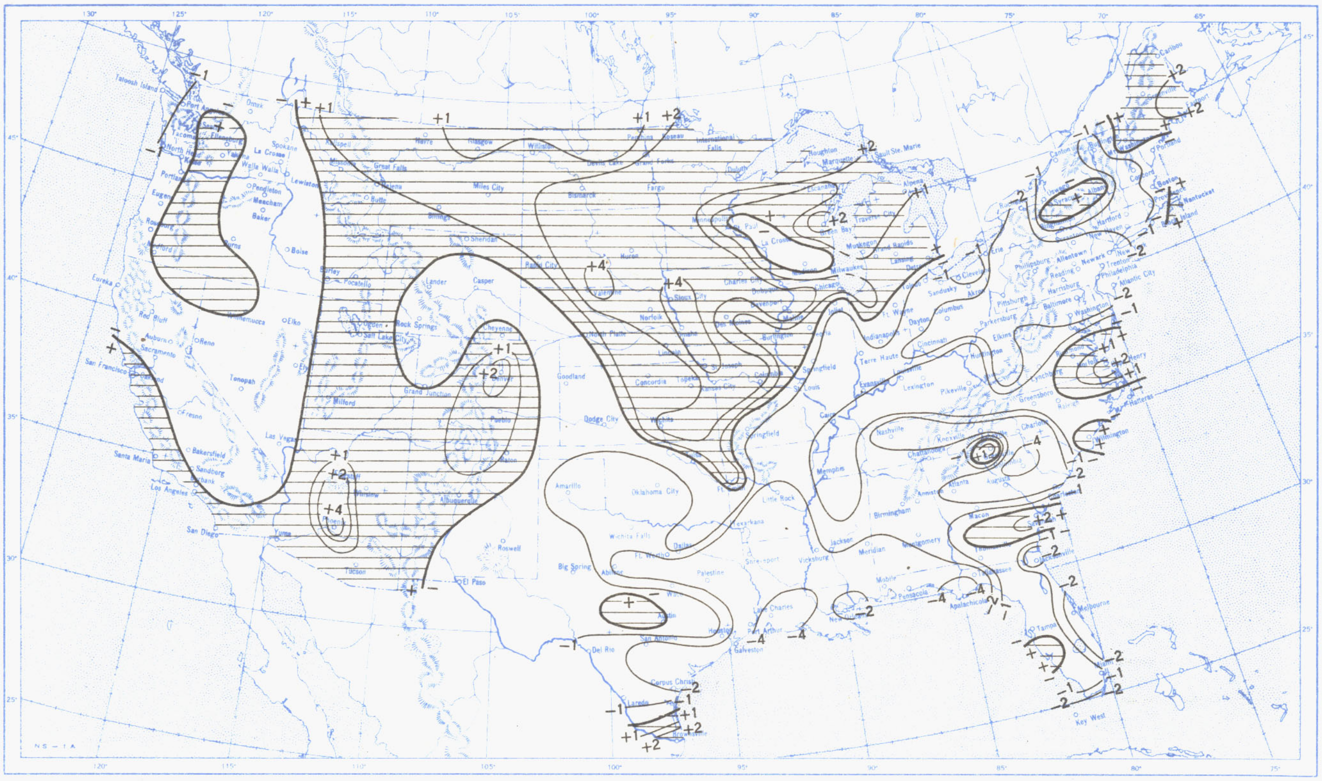
A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), August 1951.

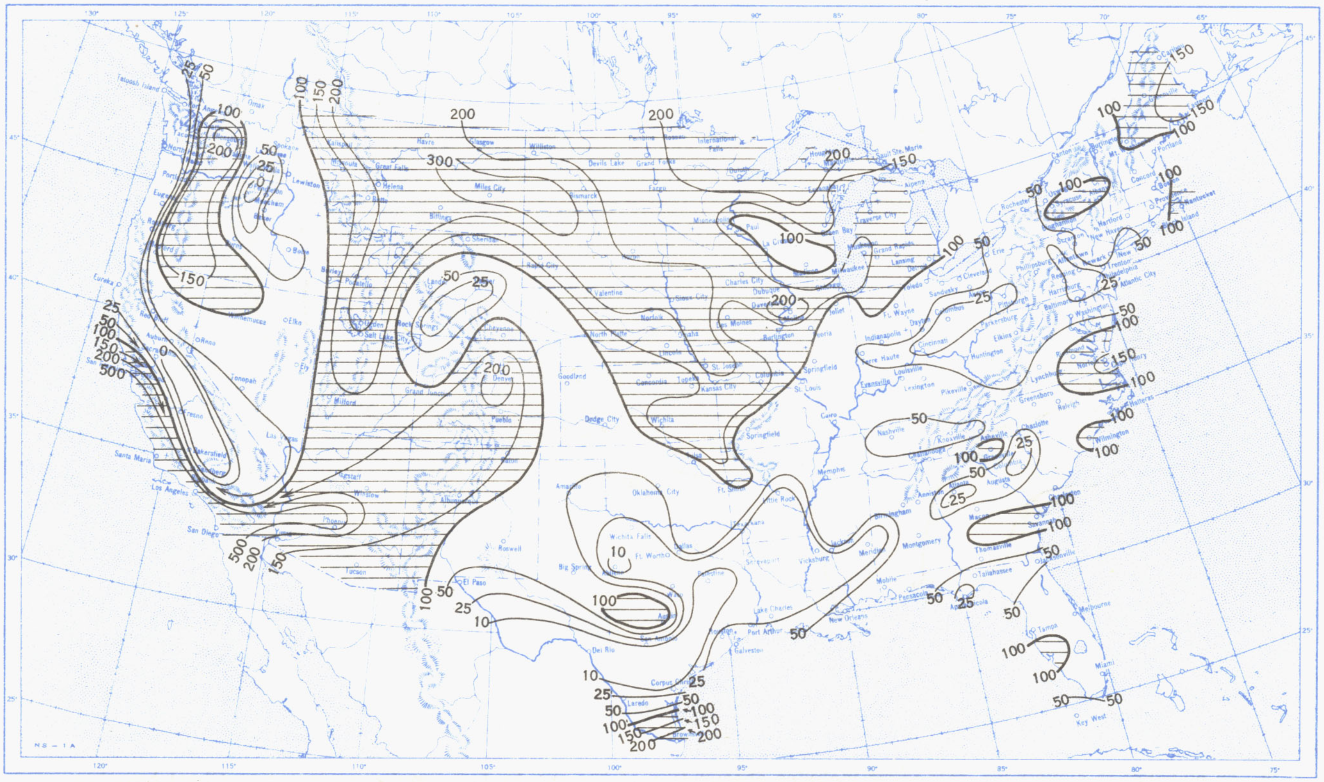


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), August 1951.

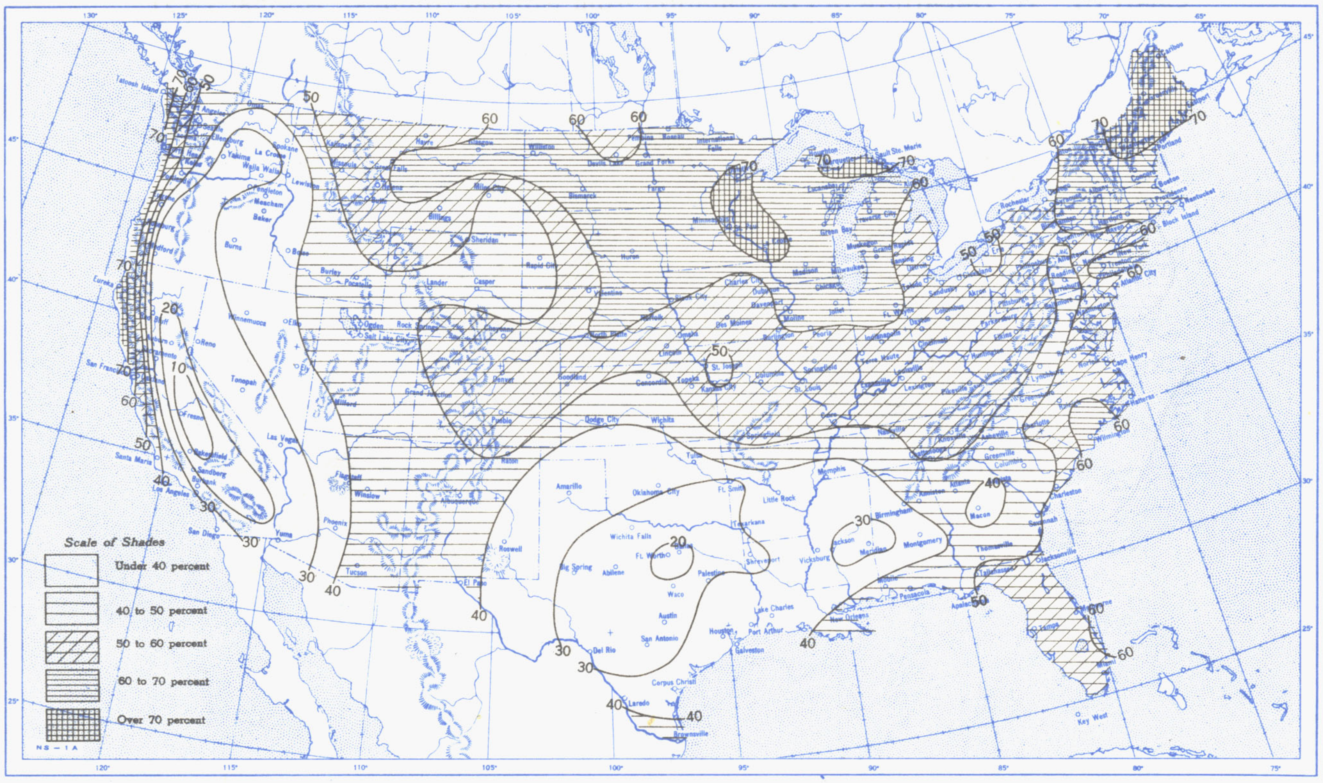


B. Percentage of Normal Precipitation, August 1951.

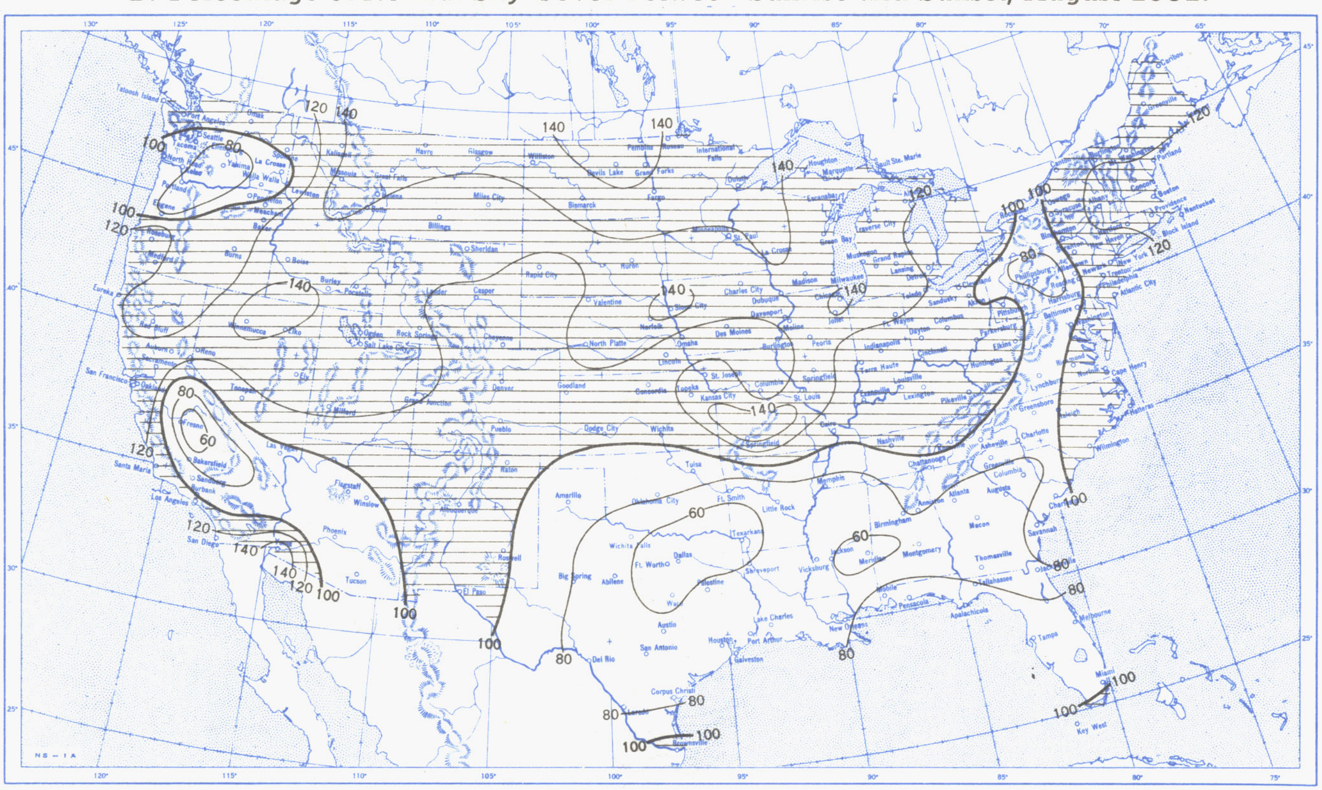


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, August 1951.

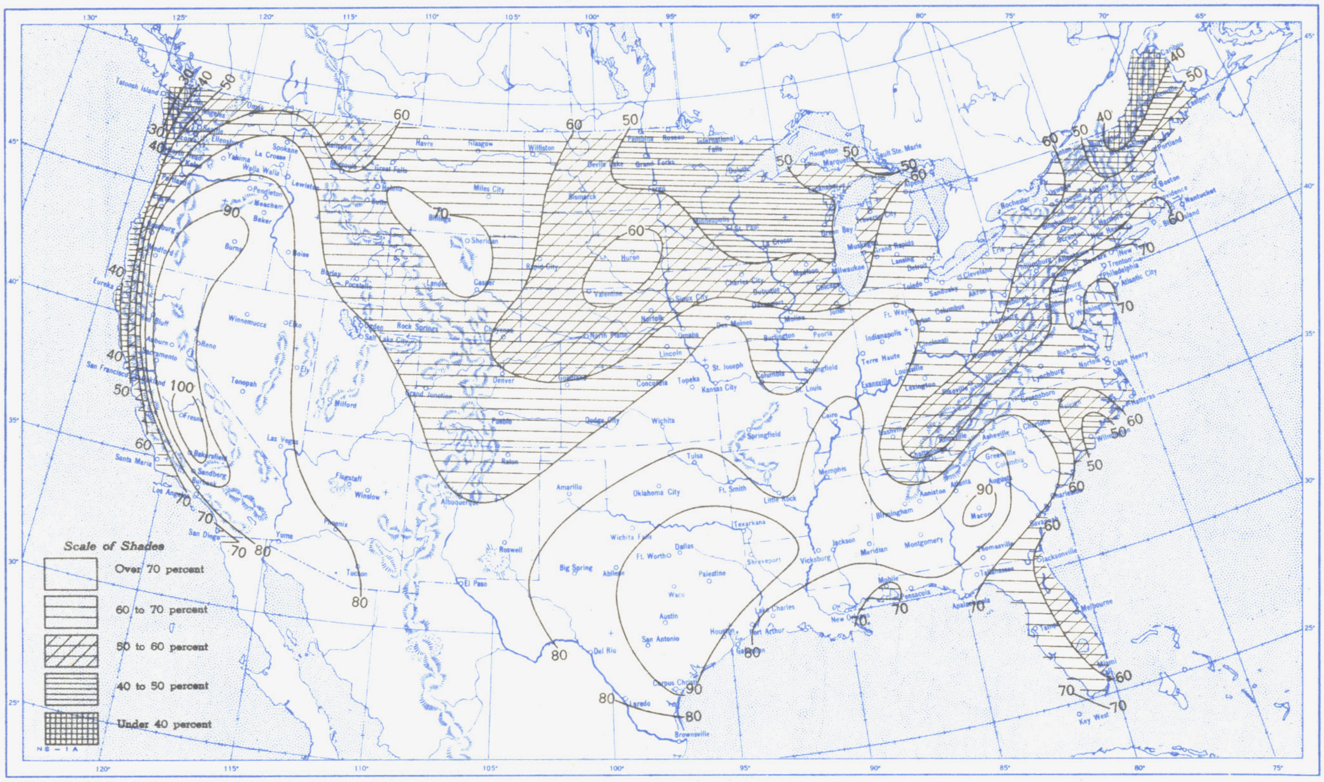


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, August 1951.

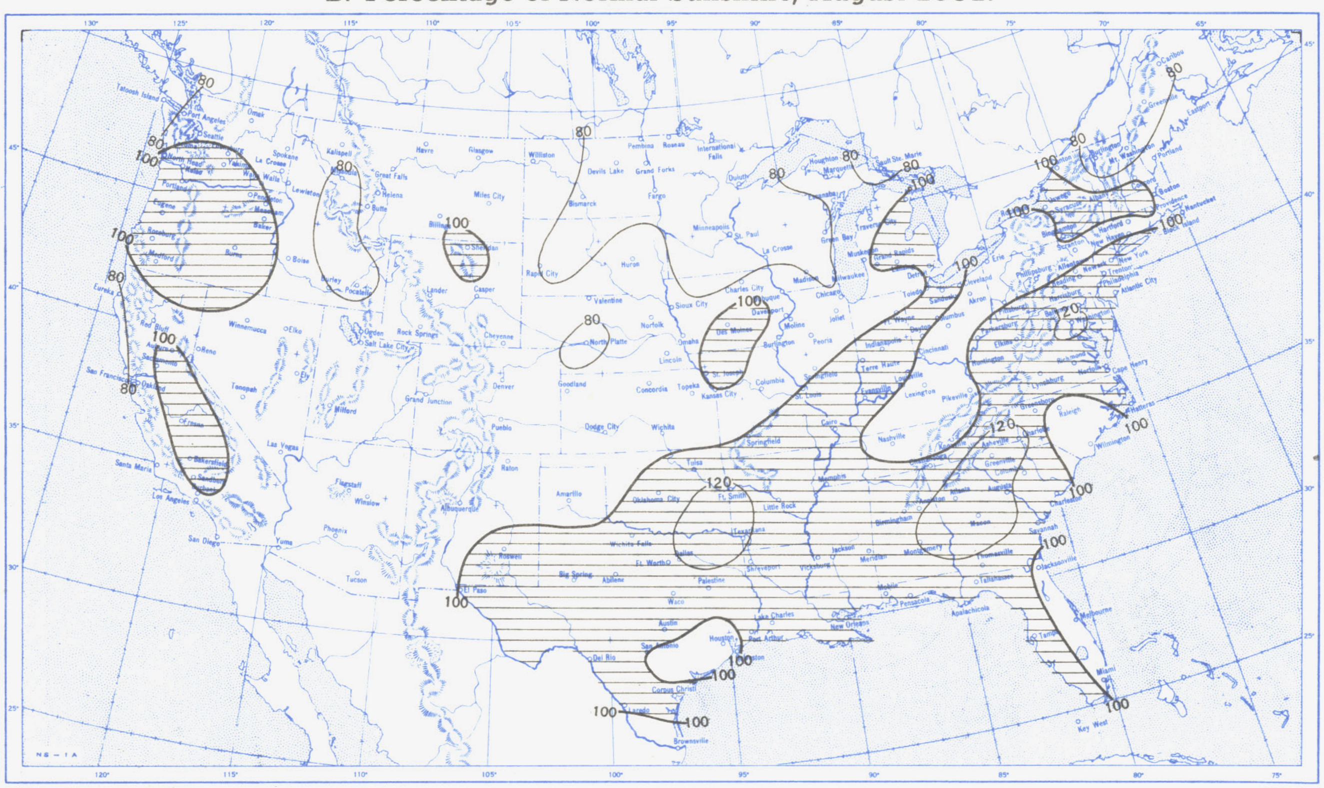


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, August 1951.



B. Percentage of Normal Sunshine, August 1951.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, August 1951. Inset: Percentage of Normal Average Daily Solar Radiation, August 1951.

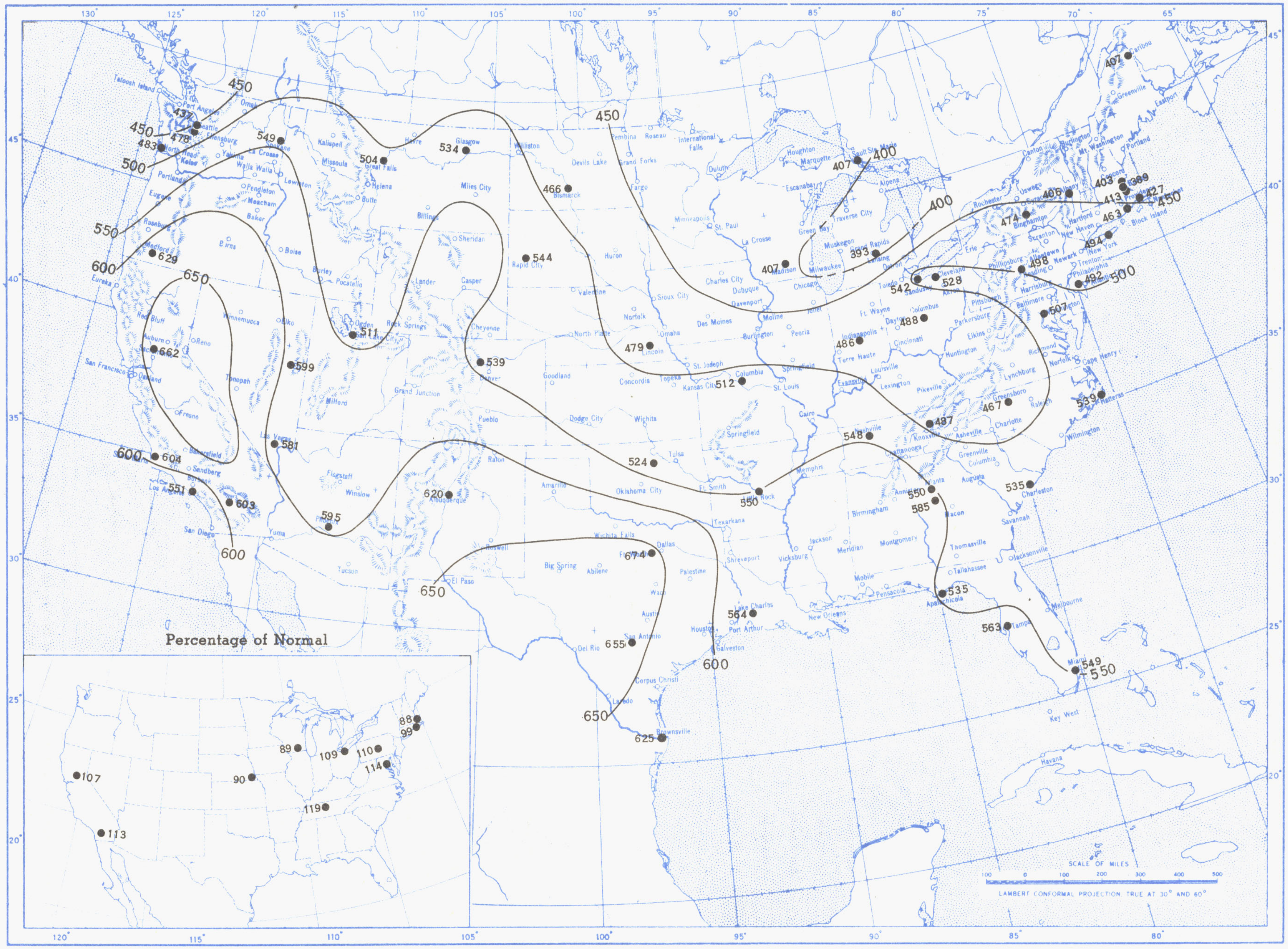
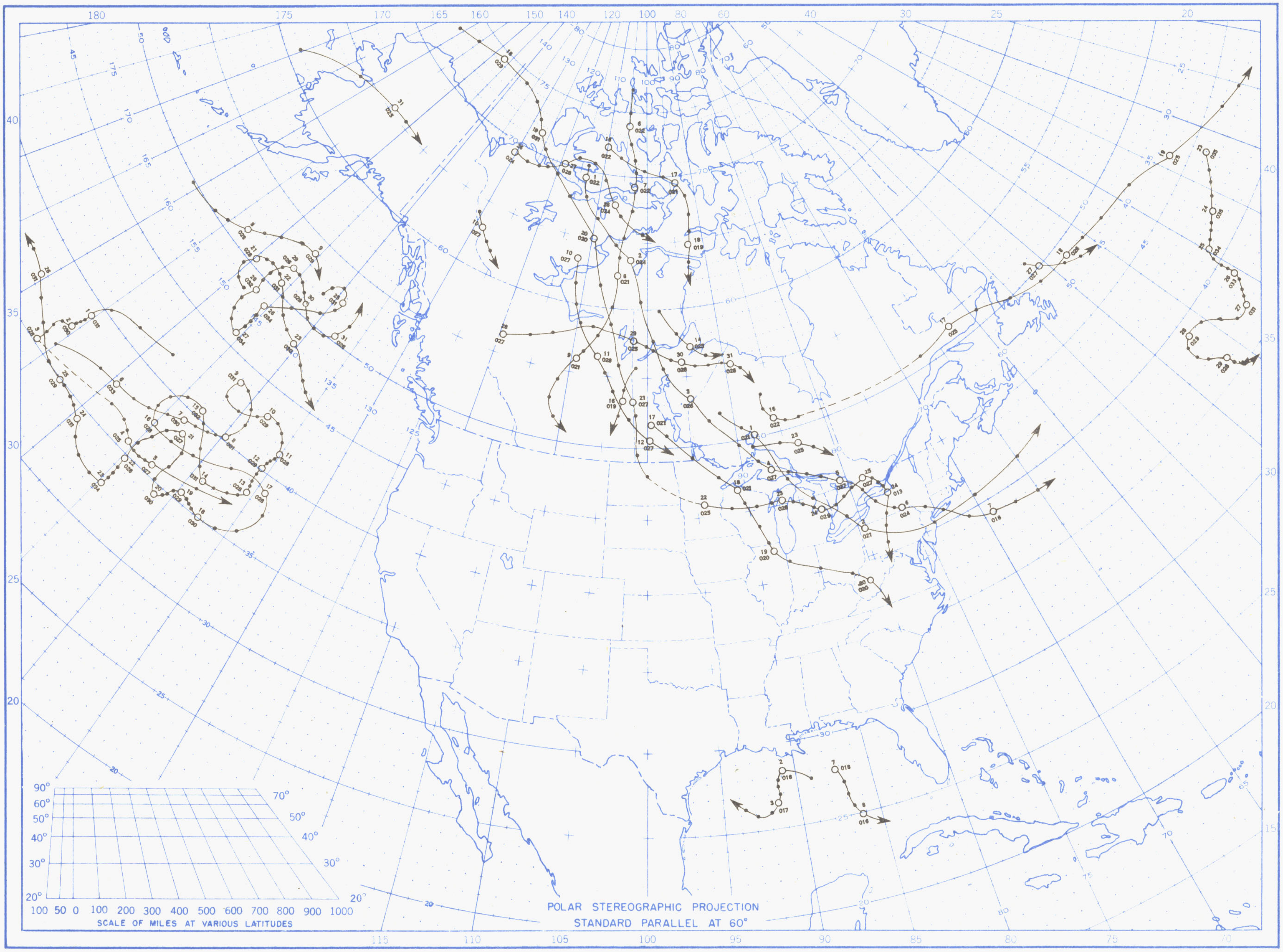


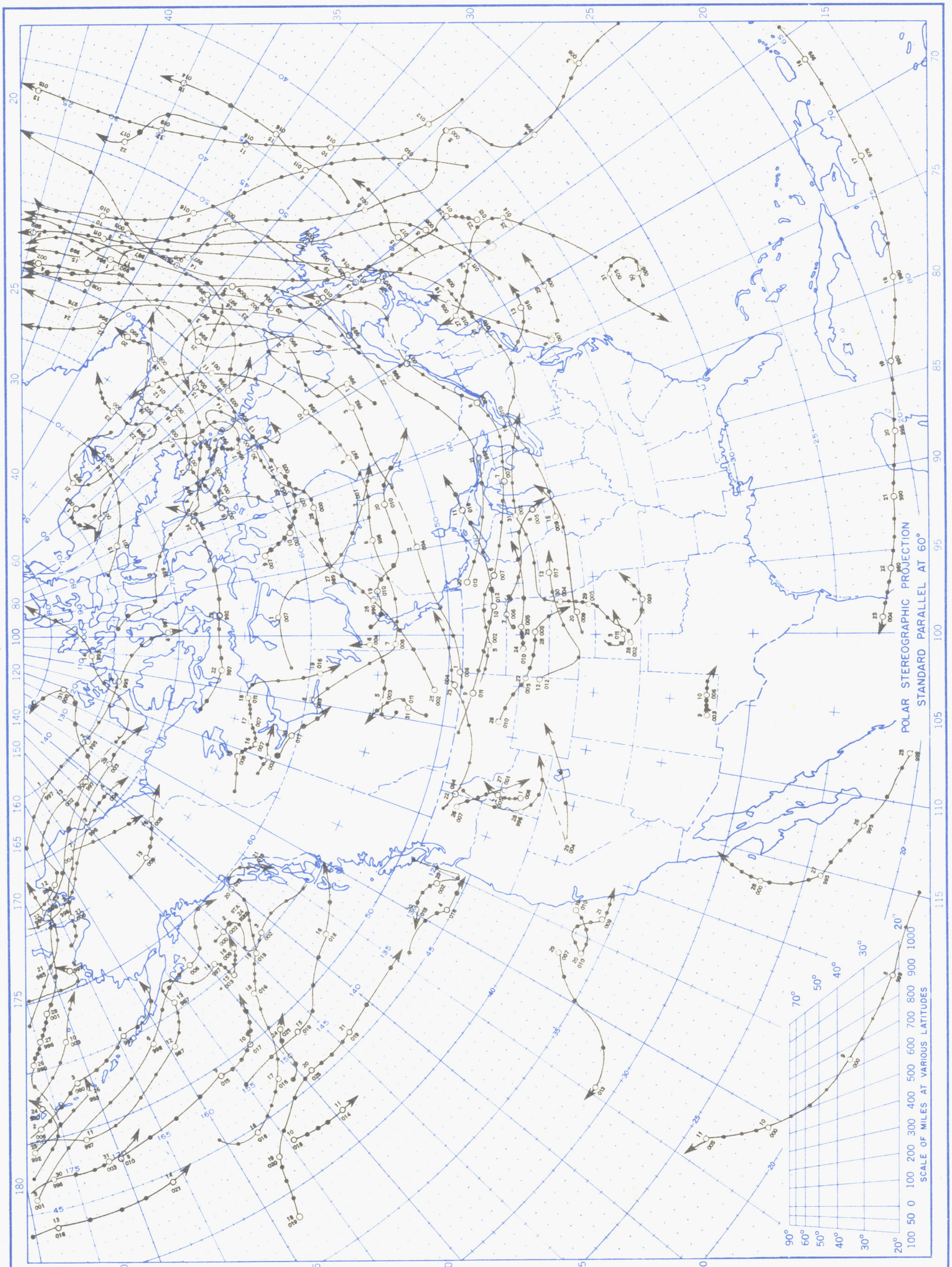
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. $^{-2}$). Basic data for isolines are shown on chart. Further estimates obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, August 1951



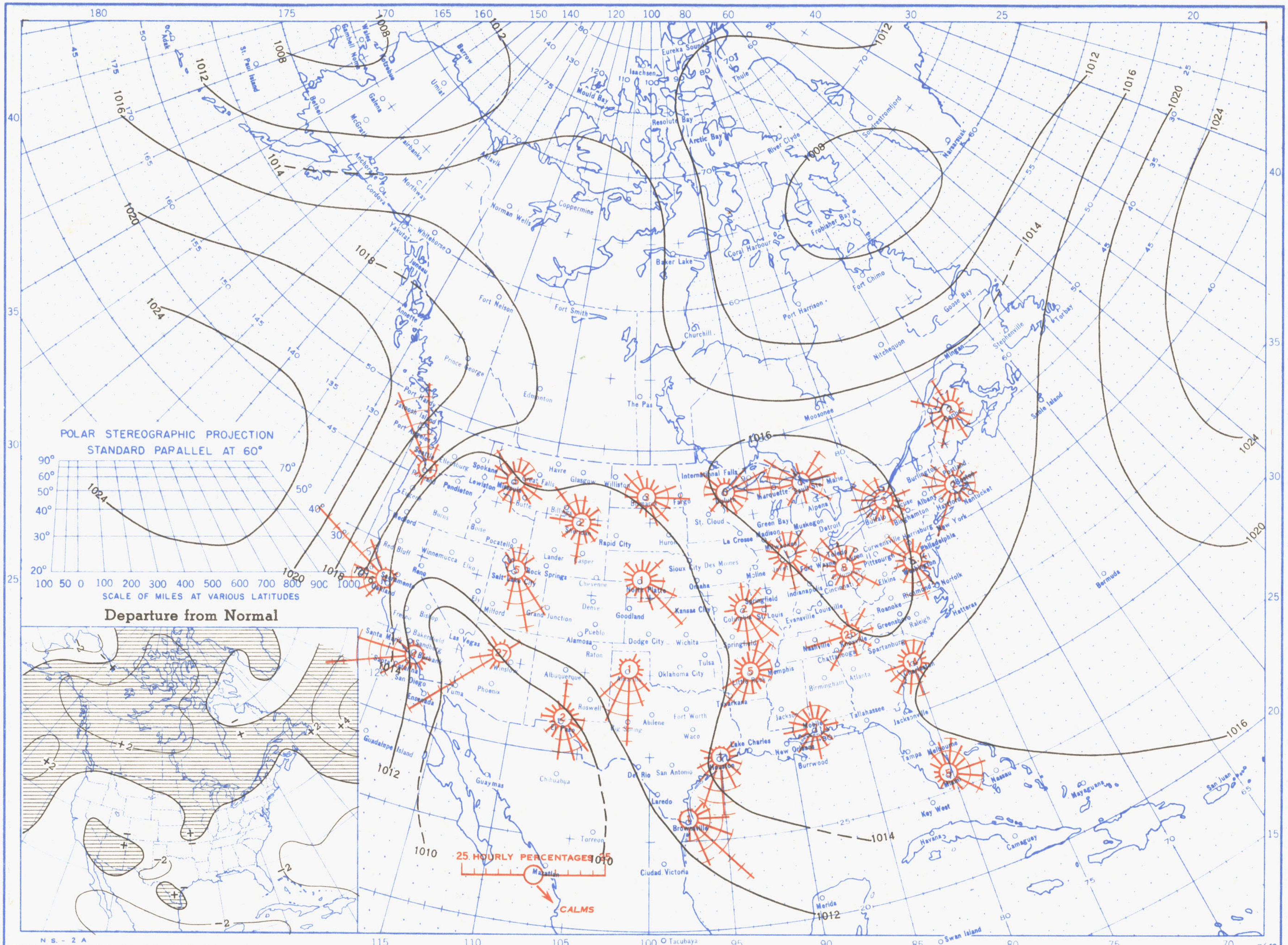
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, August 1951.



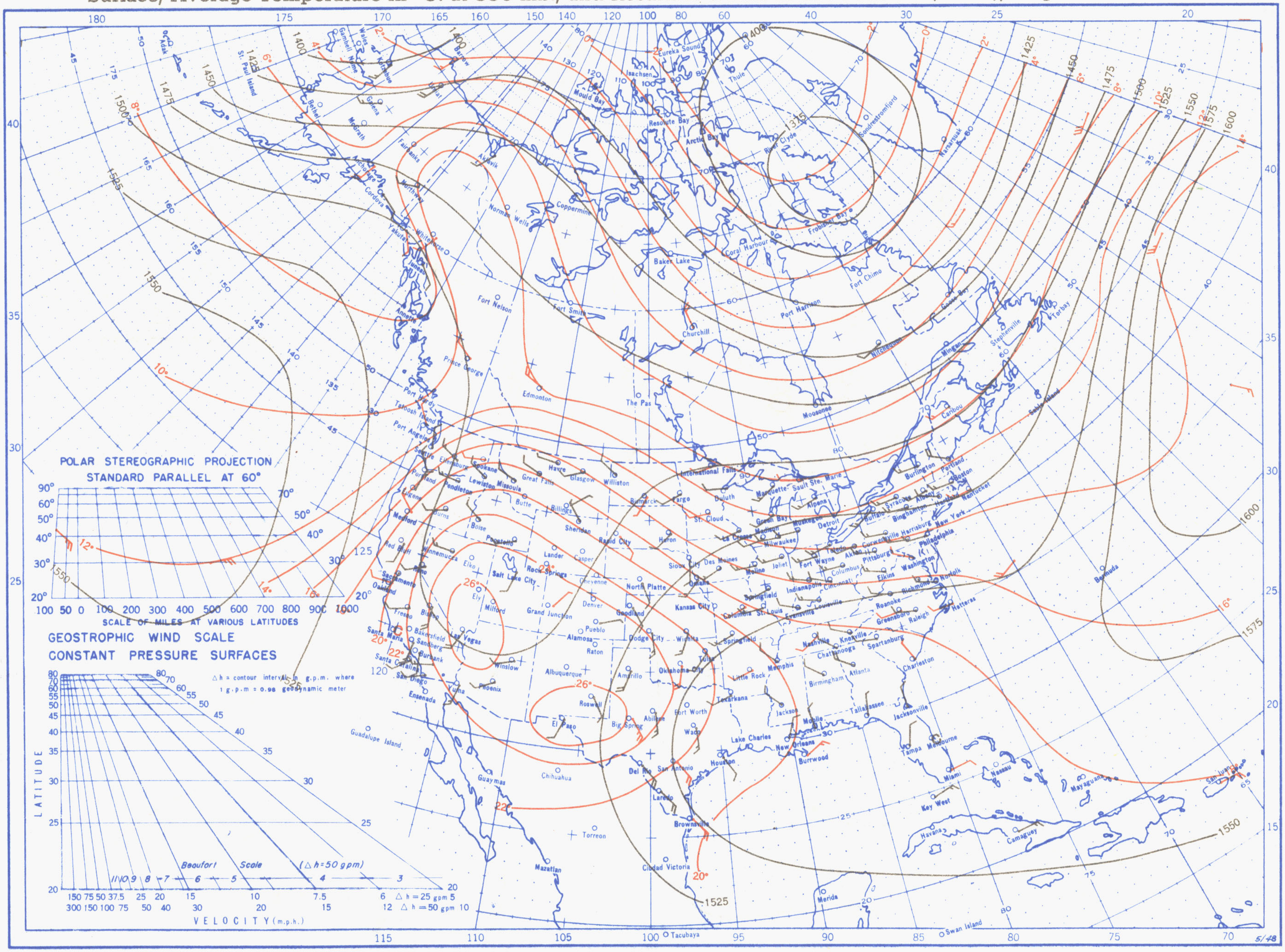
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, August 1951. Inset: Departure of Average Pressure (mb.) from Normal, August 1951.



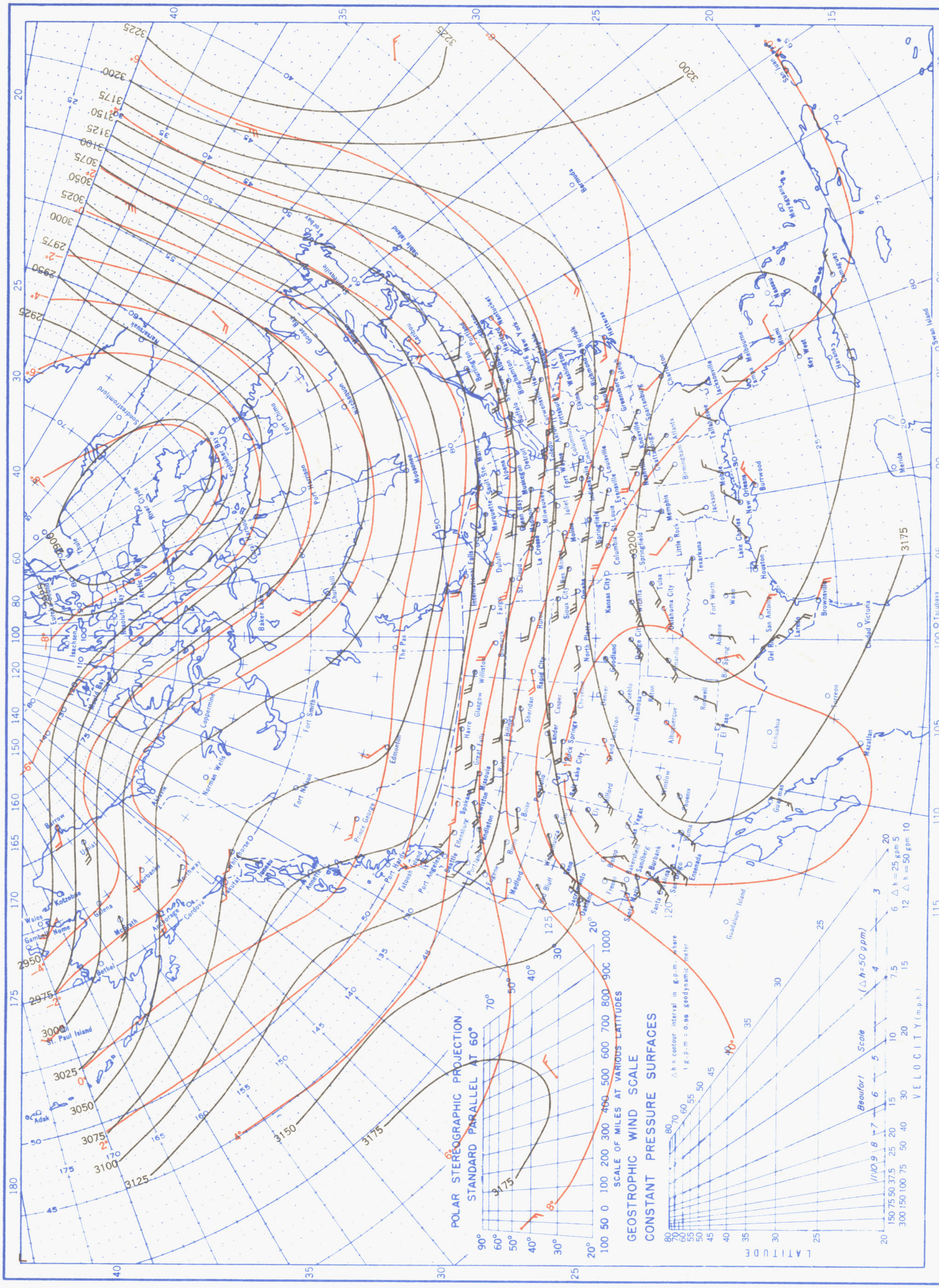
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid from map readings for 20 years of the Historical Weather Maps, 1899–1939.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), August 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), August 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

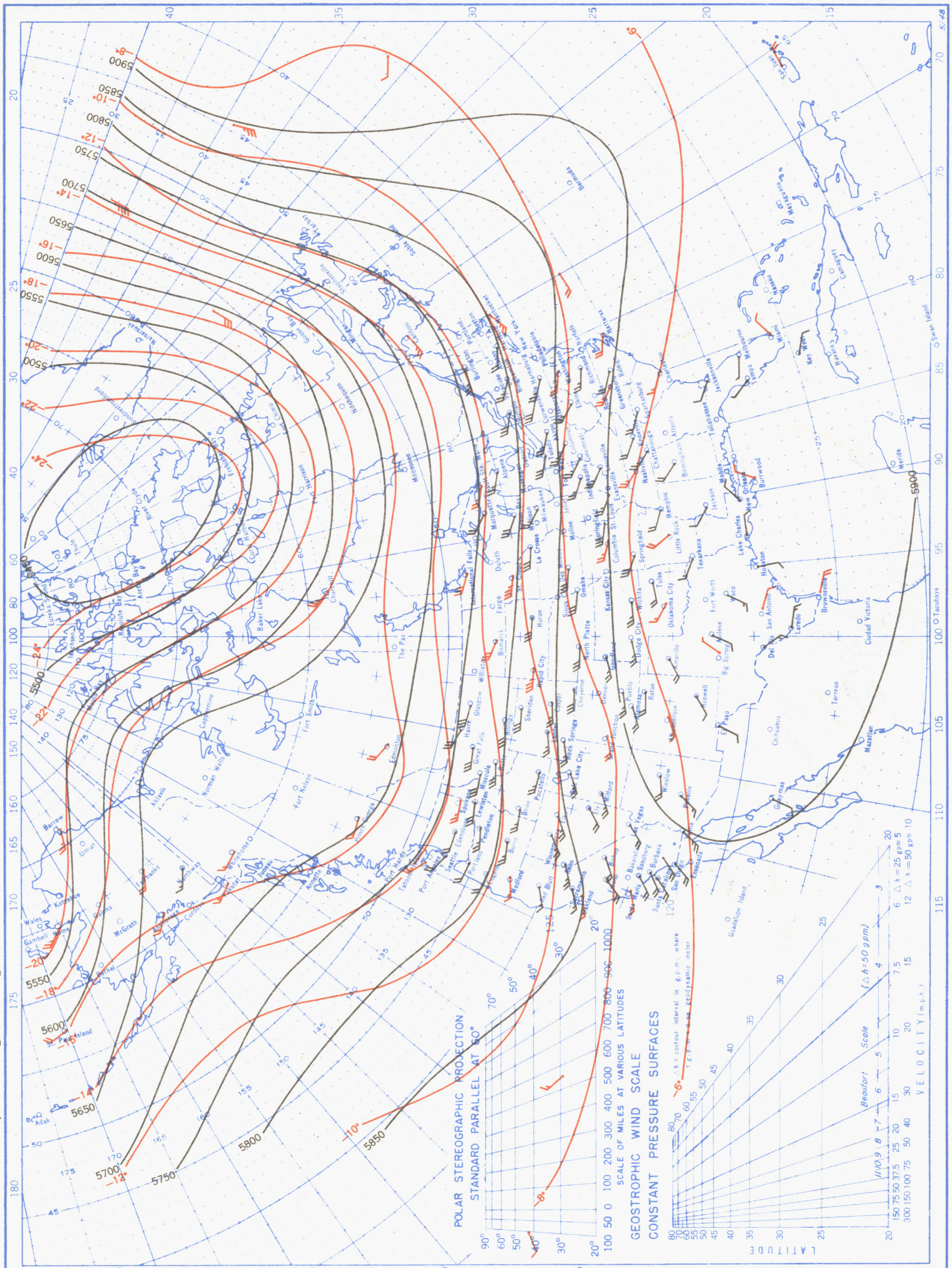
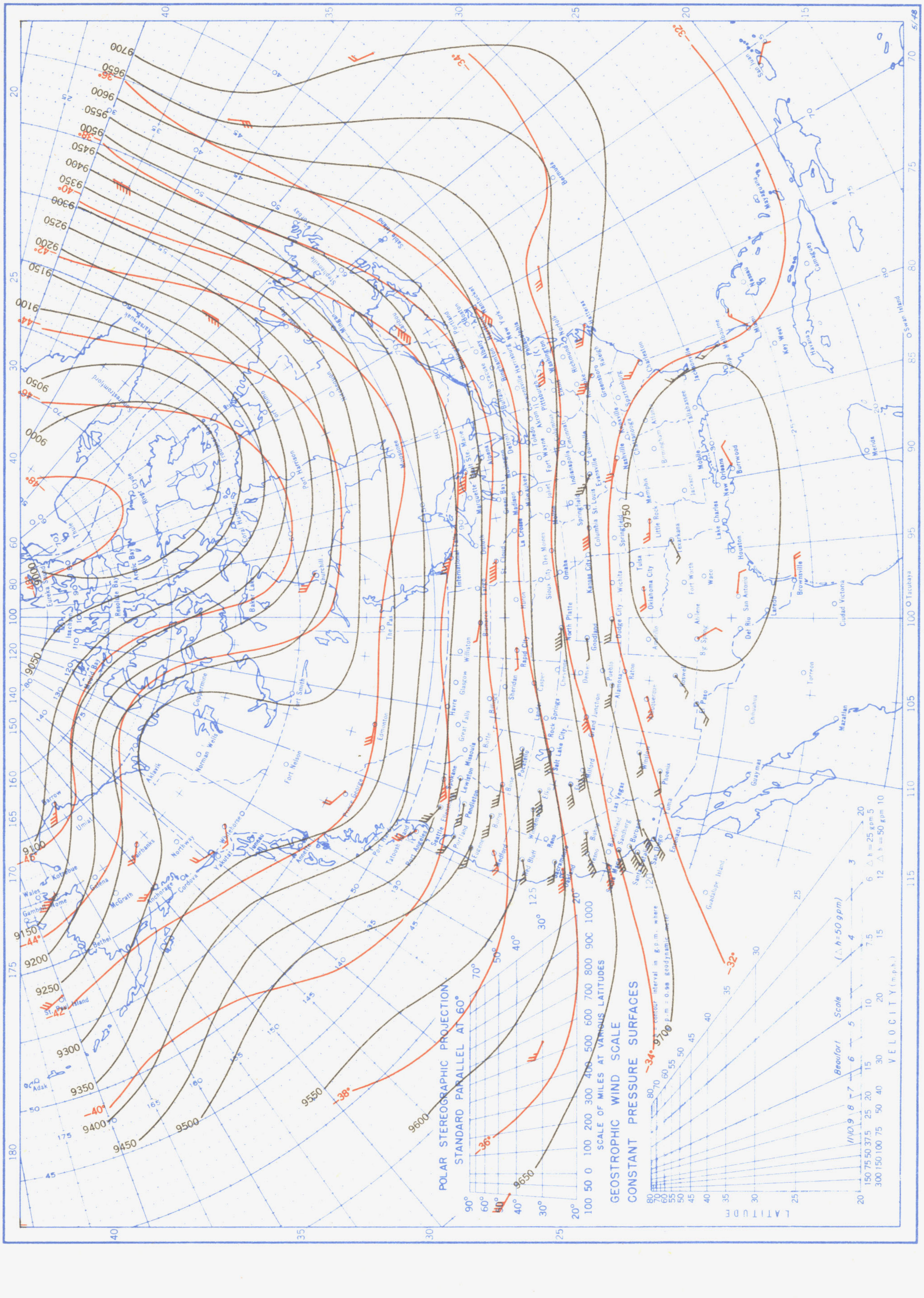


Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), August 1951.

Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), August 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.